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NOVEL METHOD AND APPARATUS FOR CONTROLLING VIDEO PROGRAMMING

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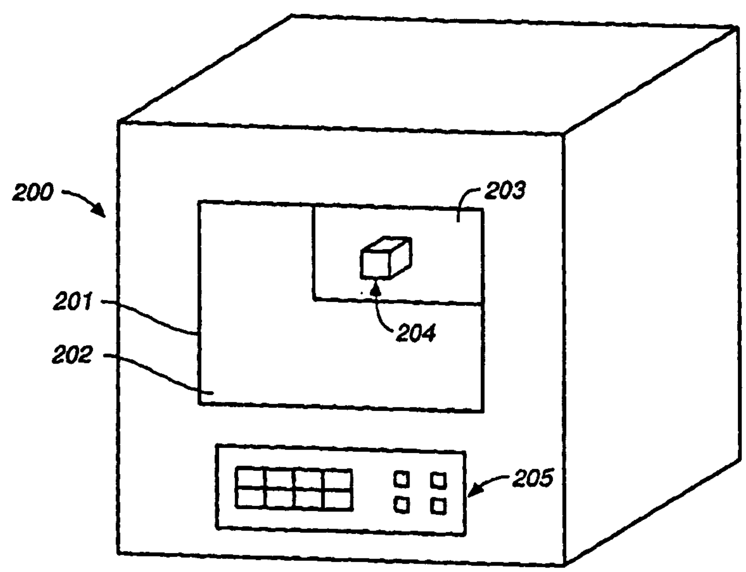

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A display screen (201) provides an image of a set of surfaces, e.g. a polyhedron (204), each one of the surfaces depicting a menu option. A remote control device is provided for providing an input signal to the television (201), which responds to the input signal by manipulating the orientation of the surfaces, and exposing the various menu options available to the user. The user can then click on the desired face of the polyhedron, corresponding to the desired option. In one embodiment, the remote control device comprises sensing means for detecting the motion and/or position of the remote control device. The polyhedron moves in a manner that tracks motion of the remote control device.

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NOVEL METHOD AND APPARATUS FOR CONTROLLING VIDEO PROGRAMMING

Cross-Reference to Related Applications

This patent claims priority based on U.S. Patent Application 09/344,442, filed June 25, 1999; 09/378,184, filed August 20, 1999; 09/378,270, filed August 20, 1999; and 60/118,505, filed February 3, 2000, each incorporated herein by reference in its entirety.

Background of the Invention

This invention pertains to remote control devices for controlling a television.

There are numerous types of remote control devices used for controlling a television. One type of remote control device comprises a numeric keypad for punching in the number of a desired television channel, as well as buttons for selecting other options. Other types of remote control devices move a cursor on a screen to select a desired option. These techniques do not usually permit a viewer to preview a channel option before that option is selected.

Another type of option selection scheme is to provide a set of small pictures on a television screen, and permit a user to "click" on one of the pictures to select an option corresponding to that picture. Such small pictures are sometimes called "thumbnails." Unfortunately, one can only put so many thumbnail pictures on a screen due to limited resolution of the television screen.

It is an object of our invention to provide an improved method and apparatus for selecting options for controlling an image display device, e.g. a television, computer screen, video editing device, or other type of device comprising an image display.

Summary

A method in accordance with one aspect of our invention comprises the step of displaying multiple video streams on a display device such as a computer monitor or a television. In one embodiment, the screen of the display device contains a primary portion and a secondary portion. A first one of the multiple video streams (hereafter the "main video stream") is displayed on the primary portion of the screen. The second portion of the stream displays an image containing a plurality of geometric surfaces. In one embodiment, the plurality of geometric surfaces are arranged as a polyhedron. At least one of the multiple video streams is mapped onto at least one of the faces of the polyhedron. Typically, several of the multiple video streams are mapped onto associated ones of the faces of the polyhedron. Alternatively, other faces of the polyhedron display images such as icons corresponding to an option that an operator can exercise, e.g. turning the volume of a television up or down, changing a channel, or performing various video editing functions.

In accordance with another aspect of our invention, a hand-held remote control device permits a user to manipulate and/or select the video images mapped onto the geometric surfaces. In one embodiment, the position in which the remote control device is held is associated with the position of the geometric surfaces in the world coordinate system. (As explained below, the term "world coordinate system" pertains to the

orientation of an image displayed on a display screen.) Thus, by rotating the remote control device, one can rotate those geometric surfaces.

In one embodiment, the main video stream is mapped onto a flat geometric surface. By rotating the remote control device, one can also rotate the flat geometric surface upon which the main video stream is mapped.

In accordance with another embodiment of the invention, the hand-held remote control device has a scrolling wheel. By rotating the wheel, one can rotate one or more of the geometric surfaces upon which images are mapped. In one embodiment in which the plurality of geometric surfaces form a polyhedron, by rotating the wheel, one can rotate the polyhedron. By rotating the wheel, one can also rotate the surface upon which the main video stream is mapped.

In accordance with another embodiment of the invention, the had-held remote control device comprises a track ball. By rotating the track ball, one can rotate one or more of the geometric surfaces upon which images are mapped. In one embodiment on which the plurality of geometric surfaces form a polyhedron, by moving the track ball, one can rotate the polyhedron. By moving the track ball, one can also rotate the surface upon which the main video stream is mapped.

As mentioned above, in one embodiment, video streams are mapped onto the various faces of a polyhedron, and rotating the hand-held remote control device results in rotation of the polyhedron. (In one embodiment, the polyhedron can rotate about only one axis. In another embodiment, it can rotate about more than one axis.) A control element on the remote control device, e.g. a button or switch, can be used to select which

image on a polyhedron face is to be shown on the primary portion of the display device as the main video stream.

In one embodiment, the hand-held remote control device is held by a user who can rotate the remote control device, e.g. about any desired axis. Means are provided within the remote control device for sensing motion and/or position of the remote control device, and communicating to a receiver within the television that motion and/or position. A receiving circuit within the television causes the image of the polyhedron to rotate or move in a manner that mirrors the motion of the remote controller. When a face of the polyhedron depicting an image representing a desired option is facing the user, he can actuate a button or other control device on the remote controller to select that option.

In another embodiment, instead of displaying a polyhedron, the menu options displayed on the video screen can be displayed in another form. However, different menu options can be displayed and/or selected in response to the motion and/or position of the remote control device.

Brief Description of the Drawings

Figs. 1A to 1E illustrate the operation of a 3D graphics pipeline.

Figs. 2A and 2B illustrate manipulation of a 2D image.

Fig. 3 is a simplified block diagram of a personal computer (PC) coupled to a graphics controller with a 3D graphics pipeline.

Fig. 4 illustrates a television displaying an image of a polyhedron constructed in accordance with our invention.

Fig. 5 illustrates a remote control device for controlling the television comprising position or motion sensors.

Fig. 6 illustrates a remote control device for controlling the television comprising a track ball.

Fig. 7 illustrates a remote control device for controlling the television comprising a rotating wheel.

Fig. 8 illustrates a television displaying a band of images.

Detailed Description

As mentioned above, a method in accordance with our invention involves displaying an image of a polyhedron on a television or other display device. Each face of the polyhedron depicts an image representing an option that can be taken by someone operating the television.

The polyhedron and the images on the faces of the polyhedron are generated using a 3D graphics pipeline in a novel manner. In order to explain the manner in which the polyhedron and images are generated, we will first explain how a 3D graphics pipeline is normally used. We will then describe its use during a method in accordance with the invention. We will then describe remote control devices that can be used to manipulate the orientation of the polyhedron.

3D Graphics Pipelines

The 3D graphics pipeline referred to in this patent can be implemented by a combination of hardware elements, known as accelerators, and software, some of which is sometimes referred to as drivers. The partitioning between hardware and software may

vary, depending upon the CPU used and the graphics card in the system, but the overall system performs the method steps described below. Portions of the pipeline tasks can be performed by software, which is less expensive than hardware, but in general slower than hardware solutions at the present time. The hardware and software that perform the steps described below are referred to simply as a pipeline, without regard to the specific partitioning.

The following is a simplified, general description of 3D graphics pipelines. It is not intended to describe any specific product (e.g. products mentioned later in this patent). Rather, the following description is merely a general explanation of 3D graphics pipelines to assist the reader's understanding.

Currently, graphics objects created using a 3D graphics pipeline can be described as a set of geometric surfaces. One way of constructing a geometric surface in a graphics pipeline is to create a "mesh" of "primitives." A "primitive" is a small geometric surface that can be defined by a set of vertices. For example, the primitive can be a polygon (e.g. a triangle or quadrilateral) defined within the pipeline in terms of the locations (in x, y and z coordinate space) of its corners or vertices. A set of several primitives is used to define a larger 3D surface.

Instead of using primitives, such as polygons, some graphics pipelines can process geometric surface areas defined in other ways, e.g. by mathematical equations. This technique for defining geometric surface areas is called "implicit." As explained below, both techniques for defining such surface areas can be used.

For purposes of clarity of explanation, we will first describe a graphics pipeline that processes geometric surface areas using triangular primitives. Other types of graphics pipelines will be discussed later on.

In this first example, a 3D graphics pipeline constructs a 3D image of an object from a 2D pixel array (typically called a "texture map"). Fig. 1A illustrates a 2D image 2 of a set of "textures." (As will be explained below, this texture map is used to create the image of an object—in this case, a house. Image 2 includes a portion 2a, which has the appearance of bricks, portion 2b, which has the appearance of roof shingles, portion 2c, which has the appearance of a door, and portion 2d which has the appearance of a window.) 2D image 2 is stored in a digital memory in the form of an array of pixels. Each location in the memory stores a pixel, which is one or more words of data indicating the color, color saturation and brightness corresponding to that pixel. The location of the pixels within the array is typically referred to as u, v coordinates (not to be confused with the Y, U and V signal names used to describe certain video signals). (The u, v coordinates are similar to x, y coordinates of the Cartesian coordinate system. In Fig. 1A, the pixel array is an n by m array, where n and m are integers.)

As mentioned above, Fig. 1A represents a pixel array. Physically, the array comprises data loaded into a memory.

The next step in the process is to provide or prepare a geometric surface. In this example, the geometric surface is in the form of a mesh 4 of primitives 5 in three dimensional space (Fig. 1B). In the case of Fig 1B, the primitives are triangles, but other types of polygons can be used. The mesh of primitives represents a three-dimensional shape of an object O in 3D space (in the case of Fig. 1B, the shape of a house). The

position of each vertex of each triangle within mesh 4 is stored in a memory in the form of x, y and z Cartesian coordinates, relative to the object. These coordinates are sometimes referred to as model coordinates ("MC"). The process of preparing such a mesh is well-known, and described in standard graphics libraries, such as Real 3D, published by Real 3D, a Lockheed Martin Corporation, in 1996, and Direct 3D, published by New Riders Publishing in 1997.

The mesh of Fig. 1B is not displayed as such. Rather, the mesh of Fig. 1B is a representation of what is stored in a digital memory. Specifically, the memory stores the locations, in terms of x, y and z coordinates, of each vertex within mesh 4.

The next step is to map or "bind" the two-dimensional texture map of Fig. 1A onto mesh 4 of Fig. 1B. This is accomplished by mapping each triangle vertex to a location in the texture map. In effect, a list of data points is prepared that associates each vertex of mesh 4 to the u, v coordinates of a particular point (pixel) in the texture map of Fig. 1A. (The locations in the texture map to which the vertices are bound are sometimes referred to as "control points.")

This portion of the process is roughly analogous to an upholsterer choosing a piece of fabric, and binding it with a few nails to the corner of a couch being upholstered (the nails are like control points). The upholsterer subsequently asks his apprentice to finish attaching the fabric to the couch. In this case, the 3D graphics pipeline finishes the task instead of an apprentice.

Figs. 1A and 1B describe the process by which one texture map (Fig. 1A) is mapped onto one mesh 4 representing one object O. A graphics pipeline can, and often does, map one or several texture maps onto the same or several different objects.

The next step in the process is to set up a "world coordinate model" of the various objects to be displayed. This requires establishing a position and directional orientation for each object to be displayed. For example, supposing that there are to be two objects to be viewed: a tetrahedron T and a cube C (Fig. 1C). During this step of the process the pipeline is instructed that cube C is to be facing in a certain direction, and is to be located partially in front of tetrahedron T relative to a certain frame of reference. Again, the structure of Fig. 1C is not displayed per se. Rather, the graphics pipeline sets up processing of the model coordinates in accordance with the parameters of the position and orientation of the object.

The next step is to select a frame of reference. For example, it might be decided that the "viewer" will want to observe the objects from a position corresponding to a corner of the world coordinate model (e.g. position P in Fig. 1D). Thus, a virtual viewpoint, viewing direction and aperture will be selected. The parameters associated with this "viewer" define the screen coordinate (SC) system. Further, it might be decided the viewer will observe these objects with a light source located at a position L. The graphics pipeline will set up another processing pipe to process the world coordinate data into the screen coordinate data which will cause a computer screen to display the image as it would be perceived by the observer at position P (e.g. the image of Fig. 1D). In other words, the computer screen will provide an image of tetrahedron T and cube C as they would be observed by a viewer if he were standing at position P, and a light source were present at location L. This image will be provided initially as a pixel array in a frame buffer and then displayed by the computer screen. The image in the frame buffer is refreshed, i.e. regenerated according to the specifications programmed into the

pipeline, typically at about 50 to 120 times per second. There are many different methods for optimizing the pipeline, and minimizing the time spent processing the invisible parts of the objects, such as the backside of cube C facing away from the viewer. Such details are well-known to those skilled in the art, and will not be discussed in detail here.

During the above-described process constructing the pixel array and providing it in the frame buffer, the pipeline a) fetches the portion of texture map 2 "tacked" to the vertices of mesh 4 (and therefore stretched over each triangle); b) determines how and where that portion of the texture map should appear, given the orientation of the triangles relative to the viewer and the location of the light source; and c) constructs the appropriate bit map pixel array for storage in the frame buffer. The contents of this frame buffer are then displayed as an image on a computer screen.

Thereafter, the 3D graphics accelerator permits one to manipulate the displayed objects in any desired manner. For example, if one wants to rotate the image of tetrahedron T by 45° (Fig. 1E), the 3D graphics accelerator facilitates this manipulation. This is accomplished by providing a new set of parameters in the world coordinate model for the graphics pipeline indicating the new position and orientation for tetrahedron T. After this occurs, the next time the graphics pipeline regenerates the image stored in the frame buffer, the regenerated image will reflect this rotation of tetrahedron T.

Similarly, suppose that it is desired to display what would appear to the viewer if he took ten steps forward from his location at position P. The next time the graphics pipeline regenerates the image, it will generate and store another pixel array in the frame

buffer corresponding to what would appear to such a viewer, and this pixel array is provided as another image on the computer screen.

It is thus seen that the graphics pipeline is extremely useful in applications such as video games, where it is desired to simulate what would appear to a game player if he were wandering past a set of objects.

As mentioned above, some graphics pipelines create models of geometric surfaces using an implicit technique. These surfaces are often described as a function of the position coordinates, i.e. f (x,y,z), or can also contain some vertices. Control points and additional formulas associated with such surfaces are used to bind a digital pixel array (e.g. an array as shown in Fig. 1A) to the implicitly defined surface, and the process proceeds as described above. The major difference is that instead of defining surface areas in terms of primitives with vertices, the surface areas are defined in terms of mathematical equations.

Manipulation of 2D Images

As mentioned above, one embodiment of the invention is a remote controller which cooperates with video graphics circuitry that provides an image of a polyhedron, each face of the polyhedron displaying an image corresponding to a menu option. I will now explain how that image is provided. In particular, I will describe a method for manipulating a two-dimensional image.

A method for manipulating a two-dimensional image begins with the step of obtaining a two-dimensional digital image (e.g. image 10 in Fig. 2A). This step can be performed, e.g., by scanning an image such as a photograph or other picture using a

conventional digital scanner. The digital image can also be obtained from a conventional digital camera. The image can also consist of digital video image, e.g. out of a live or stored video stream, which is basically a fast succession of 2D images. However, any other source of a 2D digital image can be used. The digital image is typically stored in a memory as an array of digital values. In one embodiment, the digital values are in a compressed form, e.g. using a compression technique such as MPEG1 or MPEG2 or other formats. In the case of compressed digital values, they must first be decompressed prior to processing. Also, scanned images or digitized images from any source such as cable TV, an antenna, cameras, etc. can be used.

As mentioned above, for the case of video images, dozens of frames per second comprising millions of pixels per second must be processed. We discovered that standard graphics pipelines can be used to process frames of data sufficiently fast to process video images.

Any type of memory can be used to store the digital 2D image, e.g. semiconductor memories (SRAMs, DRAMs or other semiconductor memories), a magnetic memory (e.g. a hard disk, a floppy disk, magnetic tape, or magneto-optic disk), or other type of memory device (e.g. an optical disk). The pixels corresponding to the stored image can be stored in terms of RGB values (e.g. the strength of the red, green and blue components of the pixel color), YUV values or other values. (For YUV values, Y corresponds to the amplitude or brightness of the pixel value, U corresponds to the color and V corresponds to the saturation.) The pixel values can be encoded in other ways as well. Depending on the situation, a conversion may be required before further processing.

Next, a 3D graphics pipeline is set up. This is accomplished by providing instructions to the 3D graphics pipeline as to what is to be done with the data that is to be provided. Setting up graphics pipelines per se is well known in the art, e.g. as described in the Microsoft Direct 3D SDK (software developer kit) or Direct 3D.

Thereafter, a computer model of a planar geometric surface is generated. This computer model can comprise a set of primitives, e.g. polygons such as triangles. In another embodiment, the computer model can comprise an implicit description of a flat geometric surface. This implicit description is typically a mathematical function (e.g. a function of x, y and z) as described above.

For the case in which the planar geometric surface comprises a mesh of primitives, the number and shape of primitives and the type of primitives can vary. Fig. 2B illustrates a mesh 12 that can be used to practice a method in accordance with our invention. Mesh 12 is similar to mesh 4 described above. However, unlike mesh 4, all of the vertices of mesh 12 are coplanar (or substantially coplanar). In one embodiment, mesh 12 comprises about 5000 triangles, which would be acceptable for processing a video image. Of course, other numbers of primitives could be used.

After constructing the planar geometric surface (e.g. mesh 12), image 10 is mapped, or bound, onto the flat geometric surface. This is accomplished in the following way. For the case in which the flat geometric surface is a mesh such as mesh 12, each vertex of the flat geometric surface (e.g. the triangle vertices) is associated with an image pixel location (i.e. control point). Thus, each control point is associated with a texture coordinates (u, v) corresponding to a pixel. A table of data listing each vertex and its associated u, v texture space coordinates is set up. This is called "binding." (See Kamen,

IEEE Computer Society, IEEE Computer Graphics and Applications, Jan -Feb. 1997, Vol 17, No. 1.) For the case in which an implicit technique is used to define the flat geometric surface, control points within the implicitly defined surface are bound to pixel array coordinate space (u, v coordinates) in a manner analogous to the triangles discussed above.

After image 10 is mapped into mesh 12, the object can be manipulated by manipulating the world coordinates. The world coordinates describe where in the x, y, z space the textured plane is to appear, and what its orientation will be (i.e. what angle it should be held at with respect to the viewer). In addition, the screen coordinates for the object can be changed. As a result, when the 2D textured image is finally prepared, it can be prepared in such a manner that reflects the desired manipulation. For example, it can be rotated about any axis, magnified, shrunk, etc.

After establishing the world coordinate model and screen coordinate model, the pipeline prepares an array of pixels in the output frame buffer (OFB), including pixels showing the manipulated textured mesh 12. The array of pixels in the OFB is displayed on a CRT or other type of screen.

One can manipulate the video image by, for example, changing the world coordinate parameters, e.g. telling the pipeline to tilt the video image about any axis (including an axis perpendicular to the screen or in the plane of the screen). Thus, when the pipeline regenerates the pixel array in the OFB, the regenerated video image will appear tilted about the selected axis. Since the pipeline will regenerate the image at a preprogrammed rate according to the system used, live video will appear as live video. That is because every time a new pixel array is generated, the texture map, which

contains the incoming video frame buffer, is reread and put through the pipeline. Since the texture mapping process also contains features for pixel interpolation, an automatic resolution adaptation occurs.

One can bend or warp the image by moving the vertices about which the image is mapped. Thus, one can alter the flat geometric plane of Fig. 2B to thereby warp the image. When the pipeline regenerates the pixel array in the frame buffer, the image will appear warped.

One can move the vertices so that mesh 10 becomes a cylinder. When the pipeline regenerates the pixel array in the frame buffer, the image will appear wrapped around a cylinder. (Of course, the mesh 10 can be altered into other shapes, and the image would be wrapped around the other shape.) These modifications could be done at a speed that would create the impression in the viewer that the image was being wrapped or warped gradually.

One could magnify or shrink images by moving vertices away from or closer to each other, or moving the image closer or further from the viewer in the world coordinate system, or by re-parameterizing the model coordinate to world coordinate conversion.

Hardware and Software for Manipulating a Two-Dimensional Image

One embodiment of our invention can be practiced using a PC having the following:

1. A CPU such as a Celeron or Pentium, e g. as manufactured by Intel, or a K6 processor, e.g. as manufactured by Advanced Micro Devices.
2. 32 MB of memory or greater.

3. A 3D HW adapter. This is a type of graphics card currently available on the market. The 3D HW adapter should have 4 MB of memory (preferably 8 MB) and an advanced graphics port (AGP) interface. (An AGP interface is a type of bus standard that is well-known in the art.) Alternatively, a peripheral connection interface ("PCI") can be used in lieu of a AGP. The PCI is a type of bus standard that is well known in the art. Examples of appropriate 3D HW adapters include the TNT-2 available from Riva, the ATI Rage 128, the Matrox G400, the Trident Blade 3D and the S3 Savage.

4. The operating system can be Windows 95, Windows 98, Win2000, or any other operating system that supports direct 3D. The Windows operating system includes a standardized platform called Direct X for Windows.

In one embodiment, a user sets up the flat geometric surface (for example, a triangle mesh) in the Direct 3D windows environment. The set of instructions is then provided to the graphics pipeline, which finishes the rendering process. However, in another embodiment, the PC comprises a bypass mechanism that permits one to access the hardware accelerator directly using a software interface provided by the graphics card manufacturer.

Fig. 3 is a block diagram of a computer system 50 for generating images that can be used in accordance with the invention. Referring to Fig. 3, system 50 comprises a CPU 52, e.g. a Pentium II class CPU, comprising a cache memory 52a, a core 52b and an internal bus 52c for facilitating communication between core 52b and cache 52a. Core 52b communicates via a CPU bus 54 to a system controller 56. System controller 56 communicates with the system memory 58 via a memory bus 60. System memory 58

includes a first portion 58a which stores system memory programs and a second portion 58b that stores the texture maps such as described above.

Also included in system 50 is a PCI bus 62 for facilitating communication between system controller 56 and I/O devices 64, 66 and optionally a disk drive 68. I/O device 64 can be any type of I/O device. In one embodiment, I/O device 64 is a network interface adapter "NIA" for receiving signals from any type of network, including but not limited to satellite broadcast, cable broadcast, telephony, fiber and topologies such as Wide Area Networks (including the Internet), Local Area Networks, Local Multiple Drop Networks etc. In some embodiments, I/O device 64 can be a modem, and in others I/O device 64 is a tuner for receiving television signals etc.

In one embodiment, I/O device 66 is a video capture card with a driver. Data from the video capture card is either loaded by DMA (direct memory access) or CPU 52 into a frame buffer, typically within main memory 58. However, the frame buffer may be in other memories within system 50. In some embodiments, multiple video streams or image sources are available, such as local storage, capture card 66, NIA 64 or other, not explicitly shown sources.

System 50 also includes an AGP graphics controller 70 comprising a 3D accelerator. In one embodiment, AGP graphics controller 70 communicates with system controller 56 via an AGP bus 72. In an alternative embodiment, AGP graphics controller 70 can communicate with system controller 56 via PCI bus 62 (e.g. as shown in phantom in Fig. 3).

Graphics controller 70 uses its own local memory 74 to generate and store pixel arrays to be displayed on a video display unit 76.

It is emphasized that system 50 is only one example of a system that performs a method in accordance with our invention. Other hardware can be used as well.

The above-mentioned method can be used to manipulate image streams such as television images. This method is particularly appropriate since video images comprise a succession of frames at a rate of about 60 frames/second in North America. For instance in the case of NTSC, about 9.1 Mbytes per second throughput are required. (NTSC is an abbreviation of "North American Television Standard for Color. It is the standard used for television signals in North America.)

The system of Fig. 3 can move and tilt portions of different video images or other images onto different portions of a screen such as a television screen. In one embodiment, the images are transformed to appear on the faces of a polyhedron (e.g. a cube). As explained below, the polyhedron is used as a new type of television menu option display. In particular, a novel remote control device (described below) permits a user to turn the polyhedron to see the different images on the various faces of the polyhedron. After the polyhedron is turned in an appropriate orientation, one can "click" on a desired polyhedron face, or a portion of a desired polyhedron face, to select a desired option.

The manipulated image provided in accordance with our invention can be provided to any appropriate output device, e.g. a television screen, a video projector, a HDTV monitor, or a PC screen. The image manipulated in accordance with our invention could come from any of a number of sources, e.g. an analog or digital video input, a cable TV input, a satellite input, the internet, a digital scanner, a digital camera,

or numerous other sources. (In the case of an analog input, one would first digitize the image.)

Remote Control Device Used in Conjunction with a Visual Display Device

Fig. 4 illustrates a television 200 in which the television screen 201 is divided into a primary portion 202 and a secondary portion 203. Primary portion 202 displays a primary video image. Secondary portion 203 depicts a polyhedron 204 in accordance with the invention. Television 200 includes a controller 205 for generating an image of polyhedron 204. This controller can include the hardware elements depicted in Fig. 3. The faces of polyhedron 204 can depict video images, e.g. images of what appears on the various television channels. A given face of polyhedron 204 can also include both video images and additional information (e.g. in the form of alphanumeric characters or icons), e.g. the program name, channel number, etc. In addition, the faces of the polyhedron can depict icons concerning various options, e.g. options related to television volume, on/off switches, control of a VCR, options related to editing video images, etc. (Images corresponding to such icons are stored in a memory within television controller 205.)

Any appropriate screen and display technology can be used for television 200. Television 200 is controlled by remote control device 206, which communicates with television 200 by emitting a signal, e.g. an infrared, radio or other type of signal that can be transmitted and received. (Remote control devices that communicate with a television using infrared signals are well known in the art. See U.S. Patent 4,918,439, for example.) In lieu of, or in addition to emitting an IR or radio signal, remote control device 206 can be connected to and communicate with television 200 by a wire.

In one embodiment, remote control device 206 has the capability of sensing motion, e.g. as symbolized by arrow 207, indicating rotation of device 206. Such rotation is sensed, e.g. by techniques described below. Signals indicating such rotation are communicated to a receiver within television 200, which in turn sends commands to controller 205. A 3D pipeline within controller 205 orients polyhedron 204 in a manner that mirrors motion of remote control device 206, either identically or partially. For example, the signal depicting motion of remote control device 206 can be filtered to eliminate jerking movements.

Fig. 5 illustrates several features of remote control device 206. Element 211 is a transmitter for communicating with television 200. Element 211 is typically an IR transmitter, but it could also be an ultrasonic, radio, magnetic induction, or other type of non directional communication device. Since IR is somewhat directional, more than one emitter may be used in order to guarantee proper communication while handling remote control device 206.

Also shown in Fig. 5 are a set of buttons and displays, e.g. light emitting diodes or liquid crystal displays, possibly trackballs, etc., symbolized as three fields 212, 213 and 214. Also shown in phantom are a battery 220, a printed circuit board 221 (containing a microcontroller 222 with built in program store), and two motion detectors 230a, 230b. By calculating the difference in motion of these two detectors 230a, 230b, microcontroller 222 can determine the relative motion of detectors 230a, 230b as well as the direction of motion. The two motion detectors 230a, 230b thus permit microcontroller 222 to determine which way device 206 is turned. In response to such motion, microcontroller communicates to controller 205 the manner in which remote

control device 206 has been manipulated. Controller 205 alters the image of polyhedron 204 appropriately. The user of remote controller 206 selects an option corresponding to an image facing the user by pressing an appropriate button the remote control device. (Microcontroller 222 reads or senses the various buttons and other input devices on remote control device 206, and provides appropriate signals to controller 205 in response thereto.)

As mentioned above, controller 205 within television 200 causes motion of polyhedron 204 to mirror motion of controller 200. Each face of polyhedron 204 depicts one or more menu options that a user can select by pressing appropriate buttons on remote control device 206. In this way a user can select a television channel, increase or lower volume, turn the television on or off, select a signal source for the television (e.g. selecting between cable TV, a VCR or the internet), etc. In addition, one can cause an image on one of the polyhedron faces to appear on main portion 201 of the television screen.

In lieu of motion detectors 230a, 230b, other position or motion detection devices can be used, e.g. gyroscopes, GPS (global positioning system), or other inertia or position tracking devices.

It is noted that remote control device 206 is different from other types of remote control devices. For example, while trackballs cooperate with mechanical structures for sensing the motion of the trackball, the trackball can only be used with the ball mechanically resting against those structures. Remote control device 206 can sense its own motion although it is not mechanically tethered to other sensors, or does not mechanically rest against other sensors. In particular, remote control device 206 does not

require a stationary non-moving component to determine the motion of remote control device 206.

Remote control device 206 is a preferred structure for manipulating polyhedron 204. However, other structures can be used for manipulating polyhedron 204, e.g. control buttons or track balls. Fig. 6 illustrates a remote control device 240 comprising a track ball 242. During use, an operator rotates track ball 242. The rotation of track ball 242 is sensed by remote control device 240, and a signal is communicated by device 240 to controller 205 within television 200, which causes polyhedron 204 to rotate.

In another embodiment, a remote control device 244 is used which comprises a rotating wheel 246 (Fig. 7). During use, an operator rotates wheel 246, which is sensed by remote control device 244. A signal is thus communicated by device 240 to controller 205 within television 200, which causes polyhedron 204 to rotate.

In the above-mentioned embodiments, video streams are bound to the various geometric surfaces forming the polyhedron. The polyhedron is rotated by altering the world coordinate system that is applied to the 3D pipeline. In one embodiment, CPU 52 within controller 205 determines what change is to be made to the world coordinate system to in response to the signal controller 205 receives from remote control device 206 (or remote control device 240 or 244 as the case may be).

In one embodiment, the image on the primary portion 202 of television screen 201 is also bound to a geometric surface by a 3D graphics pipeline. One can rotate or manipulate the image on primary portion 202 of the television screen using the remote control device.

Although the geometric surfaces in second portion 203 of the television screen form a polyhedron in the embodiment of Fig. 4, in other embodiments, the geometric surfaces do not form a polyhedron.

In one embodiment, a band of images 204' is provided in second portion 203 of television screen 201 (Fig. 8). One moves band 204' by moving remote control device 206. As band 204' moves (e.g. as symbolized by arrow 208), different images become visible. For example, image 204a on the far right of band 204' will disappear and image 204b will take its place. A new image will appear at the position of image 204c.

One can select an image (or a menu option represented by that image) by selecting an image that visually appears parallel to screen 201 of television 200. In other words, by actuating an appropriate control button on control device 206, the image that appears parallel to screen 201 (typically center-most image 204d) is selected. In another embodiment, one can move a cursor (using a control button on control device 206) to point to a particular image within band 204', and then actuate another control button to select that image (or the menu option represented by that image). Alternatively, one of the positions along band 204' can be highlighted or otherwise marked as representing an image to be selected. One can move different images to the marked position to select that image.

Band 204' can be either a "closed band" or an "open band." By "closed band" I mean a band whereby scrolling band 204' far enough in one direction (e.g. rotating the band 360 degrees to the right) will eventually result in the same images being returned to their original position. This is to be contrasted with an open band of images in which

moving the images to the right, for example, will eventually expose a left-most image, with no image exposed to the left of that left-most image.

Selection of images on a face of polyhedron 204 can be accomplished in a manner similar to image selection for band 204'.

While the invention has been described with respect to specific embodiments, those skilled in the art will appreciate that changes can be made in form and detail without departing from the spirit and scope of the invention. For example, instead of using a polyhedron, other multi-face images can be used in the above-described manner. Further, a plurality of polyhedra or bands can be depicted and manipulated on a television screen. Each face of the polyhedra or bands can include two or more portions that can depict various options. As mentioned above, instead of using motion detectors within the remote control device, position detectors can be used. Different types of display devices can be used in conjunction with our invention, e.g. CRT screens, LCD screens, or other display devices. Accordingly, all such changes come within the invention.

I claim:

1. Method comprising:

providing a display screen and a control device, said display screen displaying a plurality of surfaces, an image being depicted on each of said surfaces within said plurality of surfaces;

actuating a control input to said control device; and

manipulating the orientation of said surfaces in response to said control input.

2. Method of claim 1 wherein said images on said surfaces are provided by a graphics pipeline.

3. Method of claim 1 wherein at least some of said images comprise video streams.

4. Method of claim 1 wherein said images on said surfaces depict menu options, said method further comprising the step of selecting one of said depicted options.

5. Method of claim 1 wherein said control device is a remote control device that senses the motion and/or position of said remote control device.

6. Method of claim 1 wherein said control device is a remote control device comprising a rotation wheel, such that a user can rotate said rotation wheel, said step of manipulating comprising the step of manipulating the orientation of said surfaces in response to said rotation.

7. Method of claim 1 wherein said control device is a remote control device that comprises a track ball, such that a user can rotate said track ball, said step of manipulating comprising the step of manipulating the orientation of said surfaces in response to said rotation of said track ball.

8. Method of claim 1 wherein said surfaces form a polyhedron, said act of actuating changing the orientation of said polyhedron.

9. Method of claim 8 further comprising the step of applying said images to said polyhedron with a graphics pipeline.

10. Method of claim 1 wherein said surfaces form a band of images.

11. Method comprising the steps of:

displaying a set of images on a display screen, said images corresponding to a control option that can be exercised, such that the display of said images represents a display of a list of control options that can be exercised;

actuating a control to thereby move said plurality of images on said screen, thereby changing the list of options being displayed that can be exercised.

12. Method of claim 11 wherein at least some of said images are video images.

13. Method of claim 11 further comprising the step of selecting one of said images, thereby selecting an option corresponding to said selected image.

14. Method of claim 11 wherein said images are arranged as a band of images.

15. Method of claim 11 wherein said images are arranged to form a polyhedron.

16. Method comprising the steps of:

displaying a plurality of surfaces on a display screen, an image appearing on said surfaces; and

rotating said images in response to actuation of a control device.

17. Method of claim 16 wherein the surfaces form a polyhedron.

18. Method of claim 17 wherein said screen comprises a main portion and a secondary portion, said polyhedron being displayed on said secondary portion, said method further comprising the step of selecting one of the images of said polyhedron and displaying said selected image on said main portion.

19. Method of claim 16 wherein the surfaces form a band of images.

20. Apparatus comprising:

a display device displaying a plurality of images on a plurality of surfaces; and

a control device, wherein actuation of said control device rotates said surfaces.

21. Apparatus of claim 20 further comprising a graphics pipeline for generating said plurality of images on said plurality of surfaces.

22. Apparatus of claim 20 wherein said surfaces form a polyhedron.

23. Apparatus of claim 20 wherein at least some of said images comprise video images.

24. Apparatus of claim 20 wherein each of said images depicts a menu option, and said control device is a remote control device containing a control for selecting one of said depicted options.

25. Apparatus of claim 20 wherein said control device is a remote control device that senses the motion and/or position of said remote control device.

26. Apparatus of claim 20 wherein said control device is a remote control device that comprises a rotation wheel, such that a user can rotate said rotation wheel, wherein said graphics pipeline manipulates the orientation of said surfaces in response to rotation of said wheel.

27. Apparatus of claim 20 wherein said control device is a remote control device that comprises a track ball, such that a user can rotate said track ball, said step of manipulating comprising the step of manipulating the orientation of said surfaces in response to said rotation of said track ball.

28. Apparatus comprising:

a display screen for displaying a plurality of images, each of said images corresponding to a control option;

a control device for moving said plurality of images, whereby different sets of images corresponding to different control options can be displayed on said display screen, said control device also comprising a control element for selecting one of said options.

29. Apparatus of claim 28 wherein at least some of said images are video images.

30. Apparatus of claim 28 wherein said images are arranged as a polyhedron, the orientation of said polyhedron being controlled by said control device.

31. Apparatus of claim 28 wherein said images are arranged as a band of images.

32. Apparatus of claim 28 wherein said display screen comprises primary and secondary regions, said plurality of images being displayed in said secondary region, at

least some of said images within said plurality of images corresponding to control options of what is to be displayed in said primary region.

33. Apparatus comprising:

an image display device; and

a remote control device for being held in a user's hand and for controlling the image displayed on said image display device, said remote control device detecting the angle or position at which the user is holding said remote control device.

34. Apparatus of claim 33 wherein said remote control device further comprises two motion sensors and a circuit for calculating the difference between the motion of the two motion sensors.

35. Apparatus of claim 33 wherein said remote control device further comprises a gyroscope for sensing motion and/or position of said remote control device.

36. Apparatus of claim 33 wherein said remote control device wherein the position and/or motion of said remote control device is sensed using a global position system.

37. Apparatus of claim 33 wherein said remote control device determines said angle or position without reference to the position of a fixed non-moving structure mechanically coupled to a moving structure.

38. Apparatus of claim 33 wherein said display device comprises a screen for displaying an image, said image comprising a plurality of faces, the orientation of said faces being changed in response to the position of said remote control device.

39. Apparatus of claim 38 wherein said plurality of faces form at least one polyhedron.

40. Apparatus of claim 38 wherein said plurality of faces forms a band of images.

41. Apparatus of claim 38 further comprising a graphics pipeline for providing an image on each of the faces within said plurality.

42. A remote control device for being held in a user's hand, said remote control device comprising:

first and second motion sensors; and

a circuit for determining the motion and/or position of said remote control device based on the motions sensed by said first and second motion sensors, said circuit providing a signal indicative of the motion and/or position in which the remote control device is being held.

43. A remote control device for being held in a user's hand, said remote control device comprising:

a gyroscope; and

a circuit for determining the motion and/or position of said remote control device based on motion sensed by said gyroscope, said circuit providing a signal indicative of the motion and/or position in which the remote control device is being held.

44. A remote control device for being held in a user's hand, said remote control device comprising:

first and second position sensors; and

a circuit for determining the motion and/or position of said remote control device based on the positions sensed by said first and second position sensors, said circuit providing a signal indicative of the motion and/or position in which the remote control device is being held.

45. A remote control device comprising a member for being held by the hand of a user, said remote control device providing a signal indicative of the motion and/or position in which said member is being held without said member being mechanically coupled to a second structure and generating a signal indicative of the relative motion between said member and said second structure.

46. A method for using a remote control device, said remote control device comprising:

first and second motion sensors; and

a circuit for determining the motion and/or position of said remote control device based on the motions sensed by said first and second motion sensors, said circuit

providing a signal indicative of the motion and/or position in which the remote control device is being held, said method comprising:

moving said remote control device; and

causing said circuit to calculate the motion and/or position of said remote control device; and

providing a signal indicative of said motion and/or position.

47. A method for using a remote control device, said remote control device comprising:

a gyroscope; and

a circuit for determining the motion and/or position of said remote control device based on motion sensed by said gyroscope, said circuit providing a signal indicative of the motion and/or position in which the remote control device is being held,

said method comprising the step of moving said remote control device; and

causing said circuit to emit a signal indicative of the motion and/or position of said remote control device.

48. A method for using a remote control device, said remote control device comprising first and second position sensors, said method comprising the steps of:

calculating the position and/or motion of said remote control device in response to the position sensed by said position sensors; and

providing a signal indicative of said calculated position and/or motion.

49. A remote control device comprising a member for being held by the hand of a user, said remote control device providing a signal indicative of the motion and/or position in which said member is being held without said member being mechanically coupled to a second structure and generating a signal indicative of the relative motion between said member and said second structure.

50. A method for using a remote control device, said remote control device comprising:

a member for being held by the hand of a user, said remote control device providing a signal indicative of the motion and/or position in which said member is being held without said member being mechanically coupled to a second structure and generating a signal indicative of the relative motion between said member and said second structure,

said method comprising:

grasping said remote control device and moving said remote control device to thereby cause said remote control device to generate a signal indicating the motion and/or position of said remote control device.

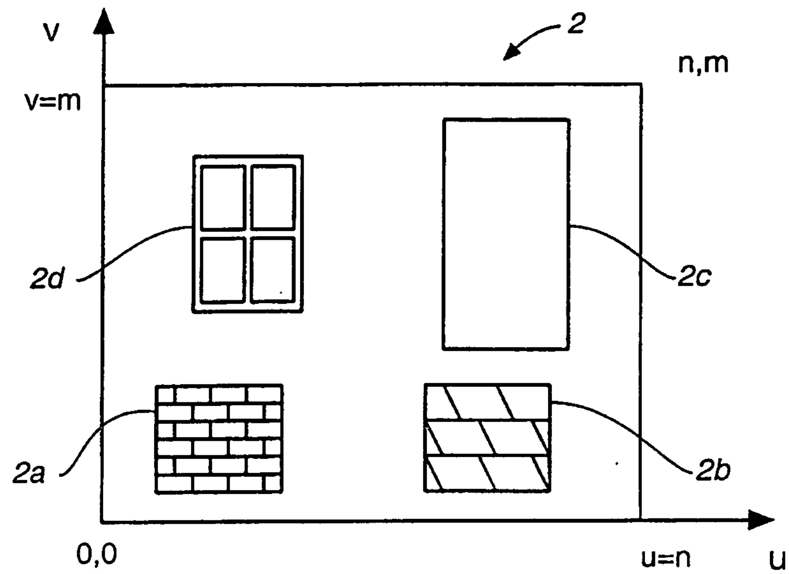

FIG._1A

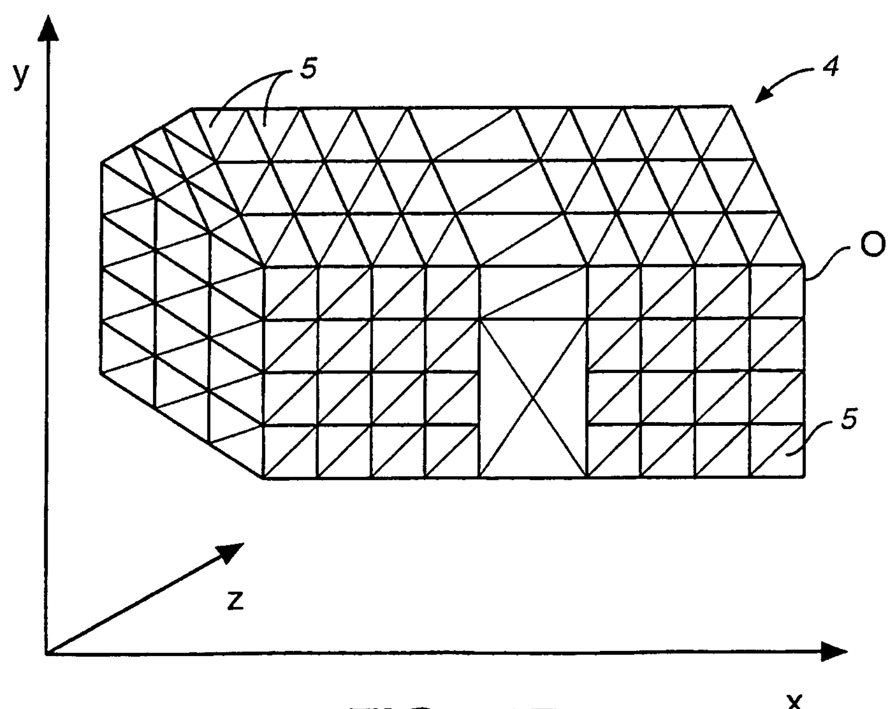

FIG._1B

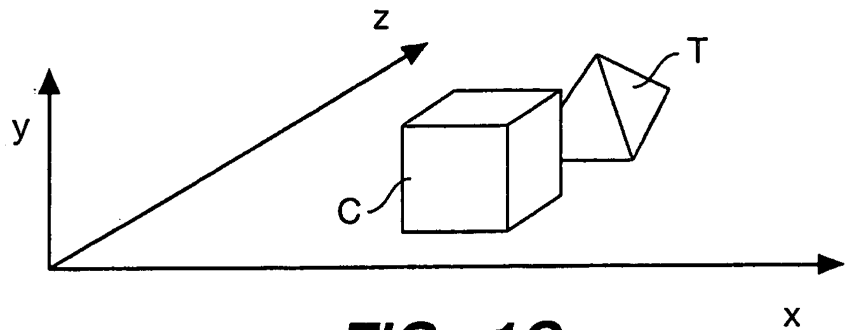

FIG._1C

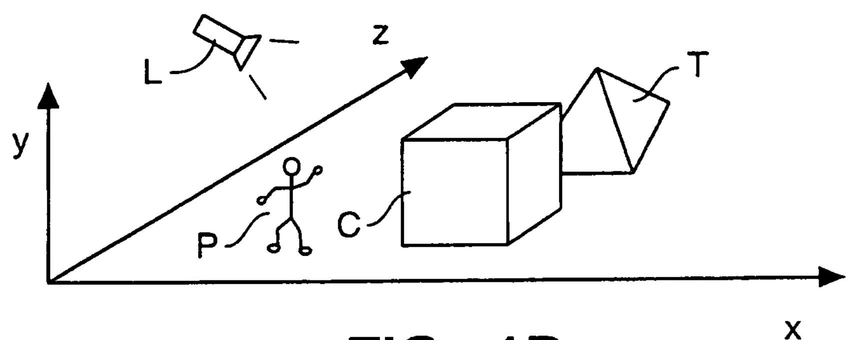

FIG._1D

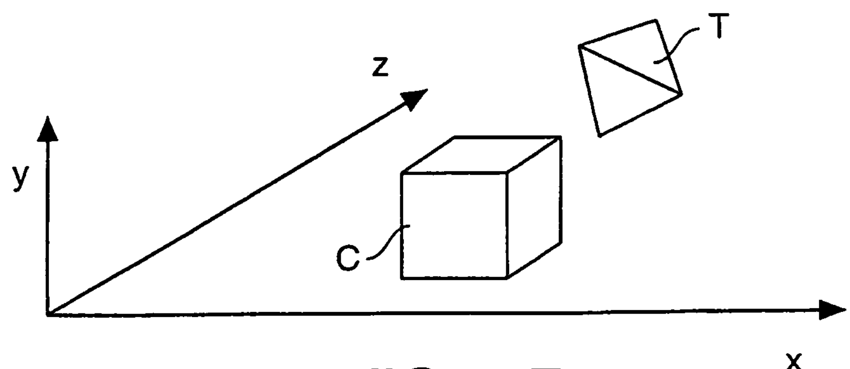

FIG._1E

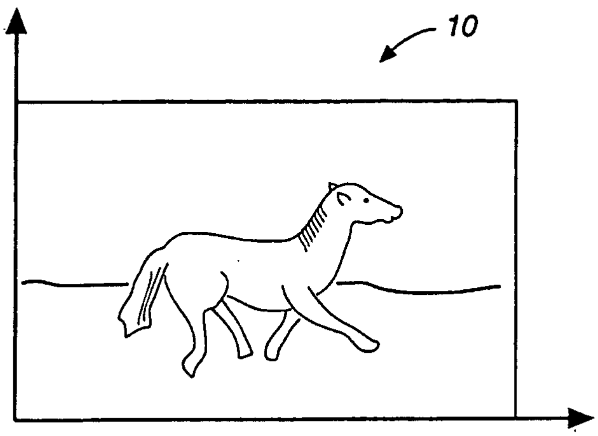

FIG._2A

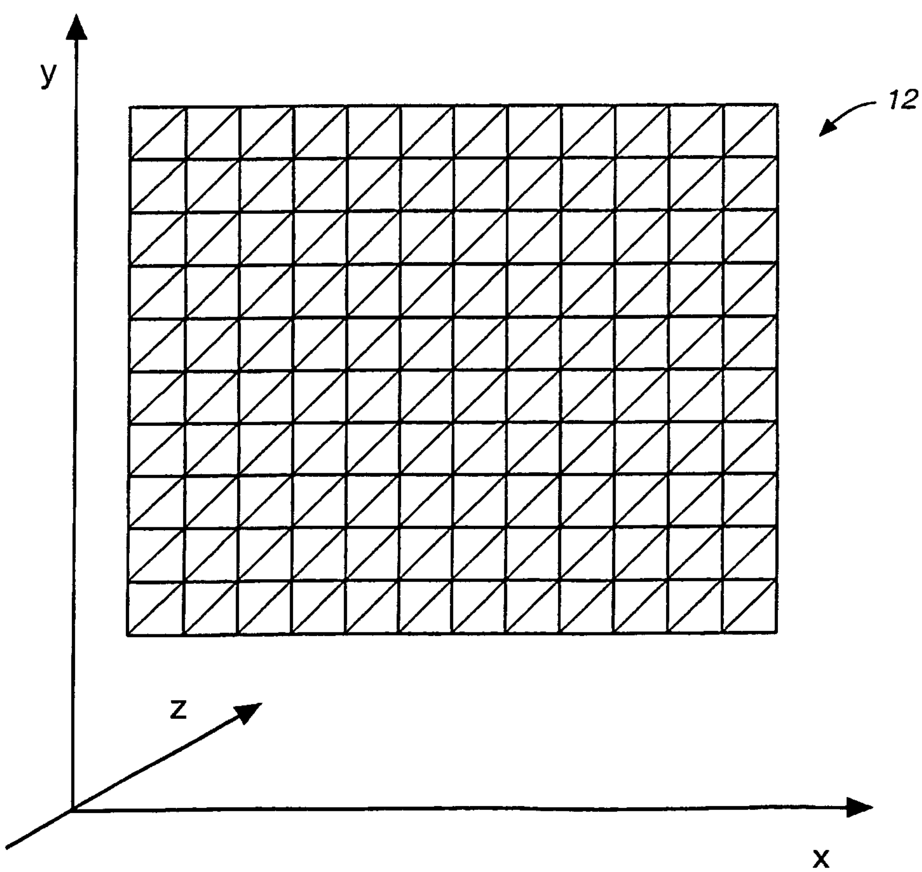

FIG._2B

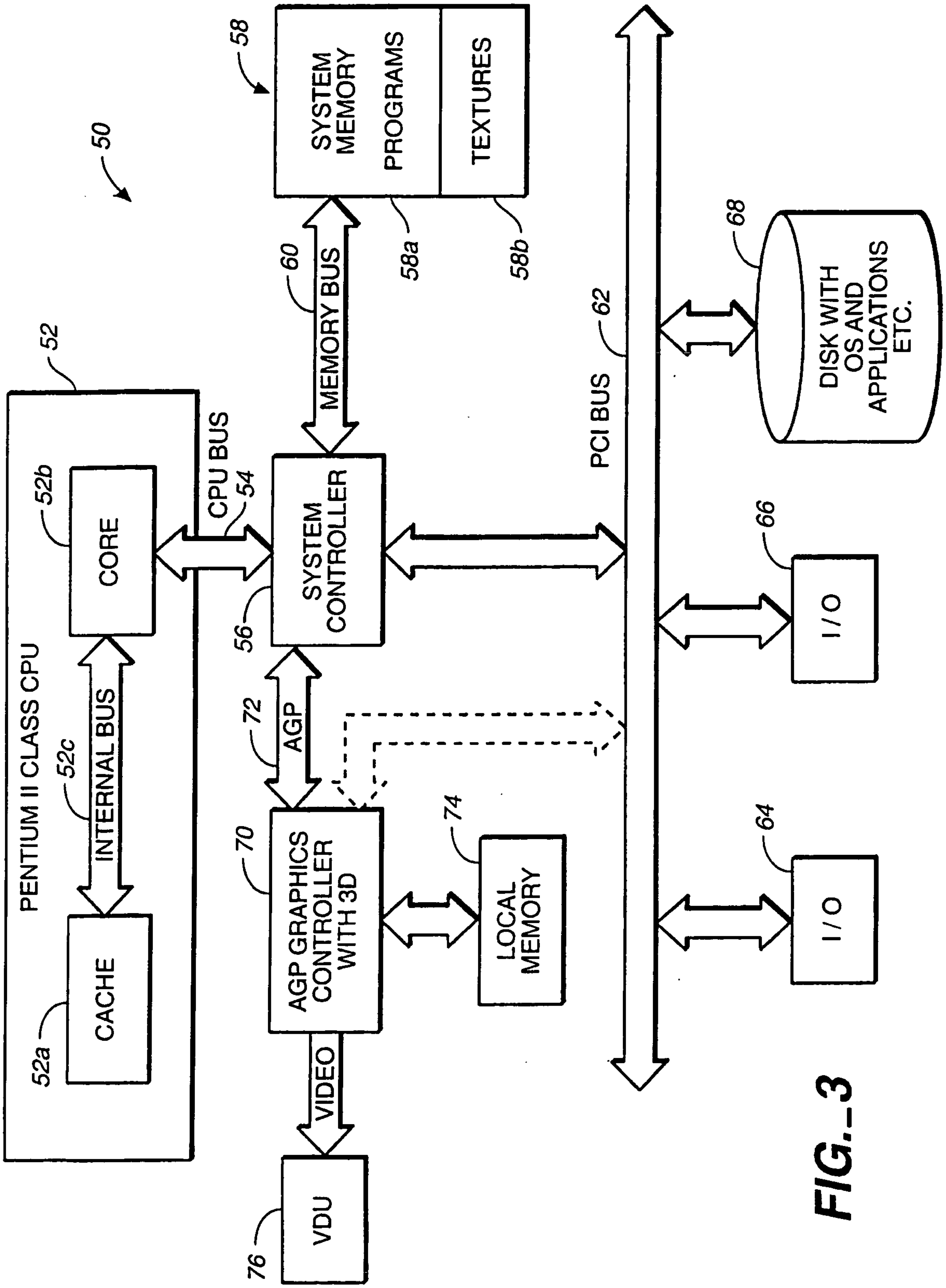
50
52
PENTIUM II CLASS CPU
52a
CACHE
52c
INTERNAL BUS
52b
CORE
CPU BUS
54
SYSTEM CONTROLLER
56
58
SYSTEM MEMORY
PROGRAMS
TEXTURES
58a
58b
60
MEMORY BUS
72
AGP
70
AGP GRAPHICS CONTROLLER WITH 3D
74
LOCAL MEMORY
VIDEO
76
VDU
62
PCI BUS
64
I / O
66
I / O
68
DISK WITH OS AND APPLICATIONS ETC.

FIG._3

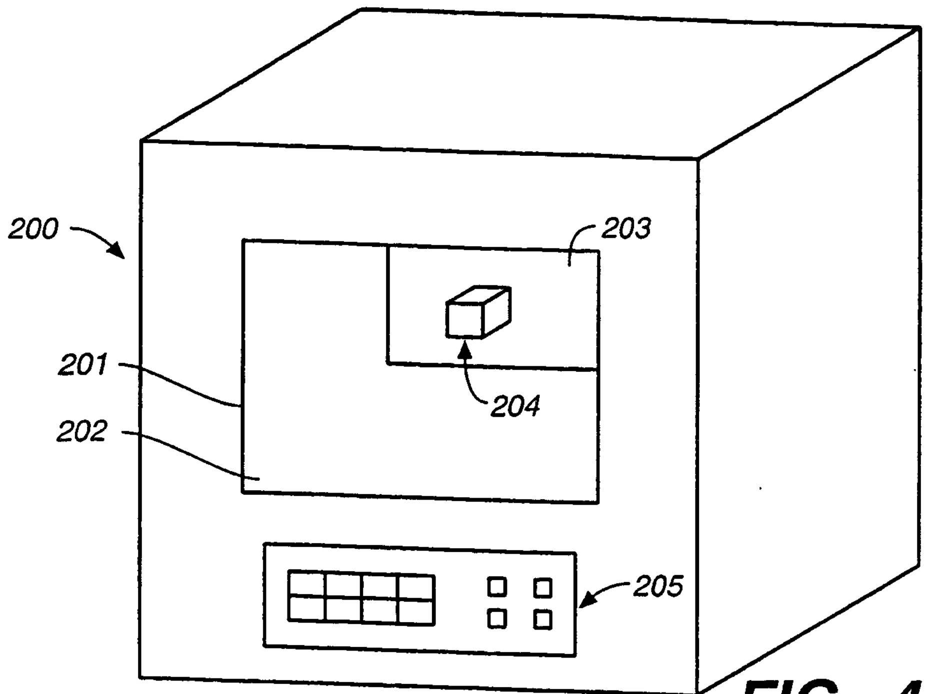
200
201
202
203
204
205

FIG._4

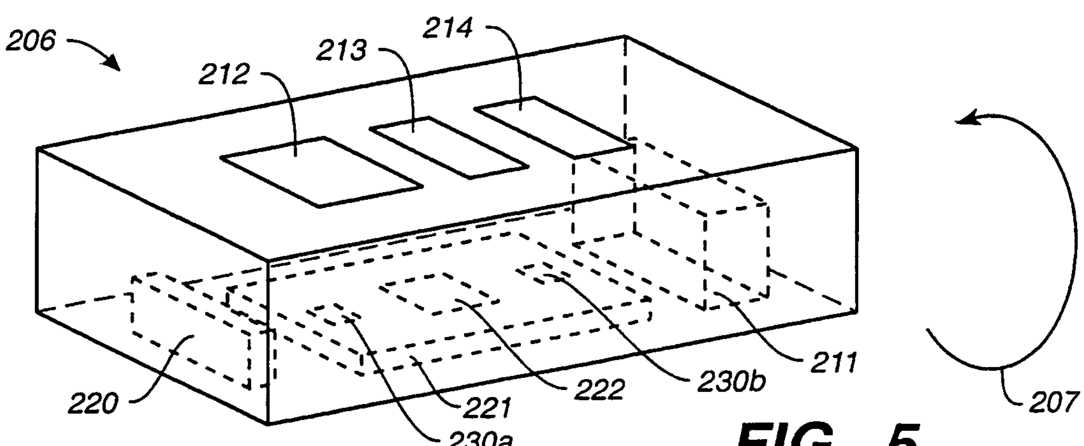
206
212
213
214
211
207
220
221
222
230a
230b

FIG._5

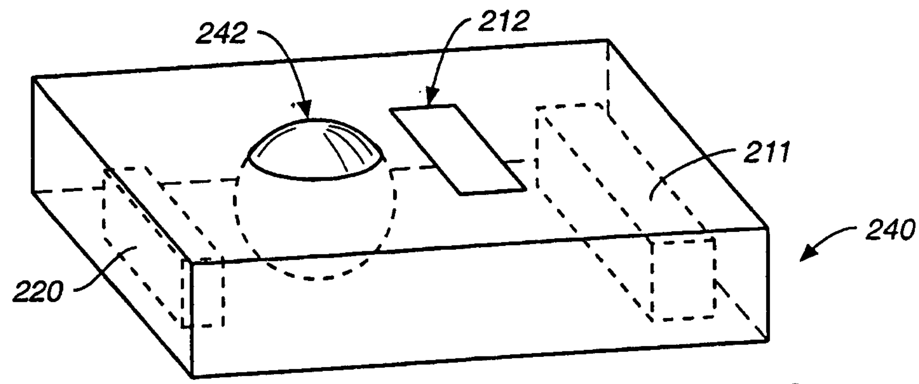

FIG._6

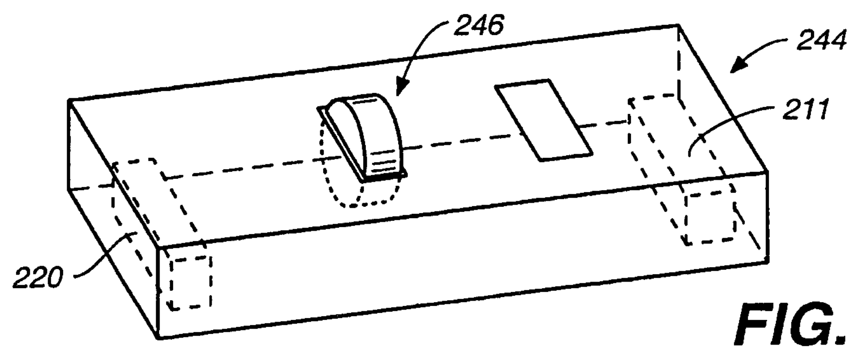

FIG._7

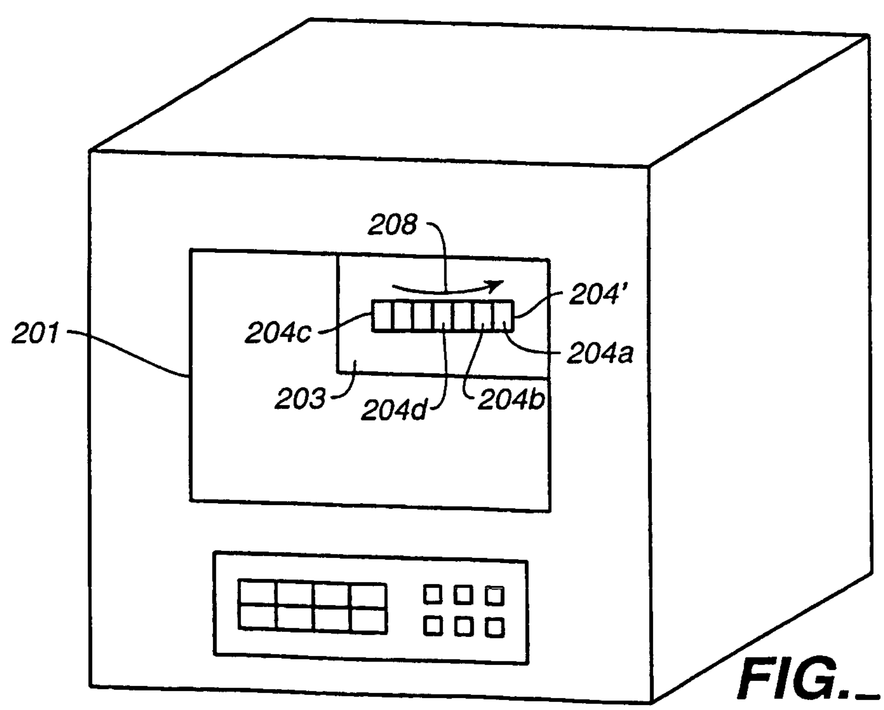

FIG._8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/02870

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 13/00
US CL :345/327
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/327, 158; 348/734

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,459,489 A (REDFORD) 17 October 1995, Whole Document	1-50
Y	US 5,515,486 A (AMRO et al) 07 May 1996, Whole Document	1-50
Y	US 5,598,187 A (IDE et al) 28 January 1997, Whole Document	1-50
Y	US 5,452,414 A (ROSENDAHL et al) 19 September 1995, Whole Document	1-50
Y	US 5,339,095 A (REDFORD) 16 August 1994, Whole Document	1-50

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 MAY 2000	16 MAY 2000

Name and mailing address of the ISA/US	Authorized officer
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